# TUNABLE TONE SQUELCH

## INSTRUCTION MANUAL

Redicom

by: KOKUSAI ELECTRIC CO. OF AMERICA
5422 W. ROSECRANS AVENUE, LAWNDALE, CALIFORNIA 90260
TEL. (213) 772-8394—(213) 679-8233

# TUNABLE TONE SQUELCH SERIES
## (VARI-TONE)

| | | |
|---|---|---|
| MODEL | ET-106 | FOR GENERAL PURPOSE |
| " | ET-111 | FOR UHF PORTABLE TRANSCEIVER |
| " | ET-113 | FOR VHF PORTABLE TRANSCEIVER |
| " | ET-115 | FOR UHF & VHF MOBILEPHONE |

INDEX


| Section | | Page |
|---|---|---|
| 1. | General description..... | |
| 2. | Specifications..... | |
| 3. | Tone Squelch Unit installation... | |
| 4. | Schematic Diagram..... | |
| 5. | P/B Interconnection..... | |
| 6. | Parts List..... | |



Issue-A: August 29, 1975

Issue-B: July 8, 1976

## 1. GENERAL DESCRIPTION

### GENERAL

The tone coded squelch is an accessory which may be added to a Transmitter/Receiver unit to provide continuous tone controlled squelch system (CTCSS). When added to the system, the decoding circuit mutes the receiver audio until a signal with the proper tone frequency is received. The encoding circuit supplies a tone to the Oscillator Modulator section of the transmitter during transmit. When it is desired to monitor the RF channel, the tone coded squelch may be disabled. If the RF channel is busy, receiver audio is present and a speech may be heard; then you cannot transmit. If the RF channel is not busy, receiver audio is present and rush noise is heard; then you can transmit. The Tone Coded Squelch Unit performs the following functions.

### Decoder

- Separates coded tone from speech.
- Determines if tone is proper frequency.
- Unsquelches receiver if tone is proper frequency.
- For monitoring, the receiver is to be unsquelched irrespective of d-c control signal from the decoder.

### Encoder

- Uses PTT* to disable the decoder and enable the encoder.
- Generates a tone for encoding the transmitted signal.

*PTT: Press To Talk switch

### CIRCUIT DESCRIPTION

The Encoder/Decoder circuit consists of a Low Pass Filter, Oscillator Driver Module, Active Band pass Filter, Resistor Array, Detector Module and Oscillator Amplifier. Detector Module, Oscillator Amplifier power source are supplied with 12 V d-c nominal value; Low pass Filter and Oscillator Driver Module, Active Band pass Filter Module power source are supplied with 1.5 V d-c which is stepped

down from 12 V d-c. These modules and one Amplifier are packed in a shield can case. The shield-can case and the Active High pass Filter (which is option) are mounted on a mother board which also contains the remaining circuit components. Since the input and output terminals are provided with feed-through capacitors, the Encoder/Decoder is free from the round-about of the transmitter output which may occur when it is used on transceivers.

## Decoding

Wide band audio is supplied from the receiver to the input of the Low pass Filter and Oscillator Driver Module. The Low pass Filter separates the tone frequencies from the speech audio. The speech audio is passed on receiver audio section via High pass Filter (option), while frequencies below 250 Hz are retained in the tone coded squelch unit for processing.

The low frequency tone is clipped at the limiter amplifier and emerges as a constant level output. This output is divided and applied to the active Band pass Filter. The output of the filter is a constant sine wave. This signal is led to the threshold detector. The detector is designed such that the tone must be in center of the pass band of the active Bandpass Filter in order to be of sufficient amplitude to exceed threshold, thereby protecting from miss decoding with rush noise. The output of the detector goes Low d-c volt with proper coded tone signal and the squelch is open. With no signal or signal with incorrect tone, the output of the detector goes high d-c volt and squelch is closed. When monitoring switch is turned on, squelch goes low d-c volt and squelch is open.

## Encoding

When terminal ⑦ of Oscillator Driver Module is supplied with power source d-c voltage, feedback oscillator in Oscillator Driver Module is turned on; then the encode tone signal is supplied. The encoding tone signal is applied through Oscillator Amplifier to tone output terminal. When d-c voltage of terminal No. ⑦ in ocsillator driver module goes back from high d-c voltage to low d-c voltage, the encoding tone signal disappears.

## TROUBLESHOOTING

In the event the coded squelch unit fails to operate, the information given below will be helpful to quickly isolate the defective component or module. If a module is determined to be defective, it should be replaced.

A-c and d-c voltages at key points are shown in the circuit. They should be considered as nominal values and actual measurements may vary slightly from one unit to another. However, any considerable deviation in a paticular reading should be investigated as indication of a defective component or moduel.

Table 1 MEASUREMENT CHART OF PRINTED CIRCUIT BOARD

| Test Point | AC mV (rms), typ. | | | DC V, typ. | | | Comments |
|---|---|---|---|---|---|---|---|
| | (Noise) Stand by | Decode | Encode | Stand by | Decode | Encode | |
| ① P1 | 60 | 60 | -- | 0 | 0 | 0 | Decoder Input |
| ② | -- | -- | -- | 0 | 0 | +12 | Encoder Power |
| P2 | -- | -- | -- | +10 | +10 | 0 | Supply |
| ③ | -- | -- | -- | +12 | +12 | +12 | Decoder/Encoder |
| P5 | -- | -- | -- | +10 | +10 | +10 | Power Supply |
| ④ | -- | -- | -- | +12 | 0 | 0 | Detector D-c |
| P | -- | -- | -- | +5 | 0 | 0 | Output |
| ⑤ | -- | 950* | 775* | 0 | 0 | 0 | Encoder Tone |
| J2 | -- | " | " | 0 | 0 | 0 | Output |
| ⑥ P1 | 60 | 60 | -- | 0 | 0 | 0 | H.P.F Input |
| ⑦ J1 | 4 | 50 | -- | 0 | 0 | 0 | H.P.F Output |
| ⑧ P3 | -- | -- | -- | 0 | 0 | 0 | Ground |

* NOTE: Value at R612 or VR1 minimum

Measurement conditions (Ambient temperature; room)

H.P.F Output Load: 5kΩ

Decoder Output Load: 50kΩ

H.P.F. Output Terminal: To be connected to the de-emphassis line of the receiver.

| | |
|---|---|
| Decoder Input Terminal: | To be connected to the Discriminator line of the receiver. |
| Standby Condition: | 0 to 5 kHz noise should be given |
| Level Meter Used: | 100 kΩ input impedance |

## Tone Selection

The tone operating frequency of coded squelch is determined by resistance between terminal 2 and 9 of Active Band pass Filter. This resistance is packed in Resistor array. Resistor array consists of up to 17 resistors. It consists of three group Modules, each module covering E.1.A tone frequency A.B or C group. The terminal pin numbers and tone frequencies are corresponded in Table 2.

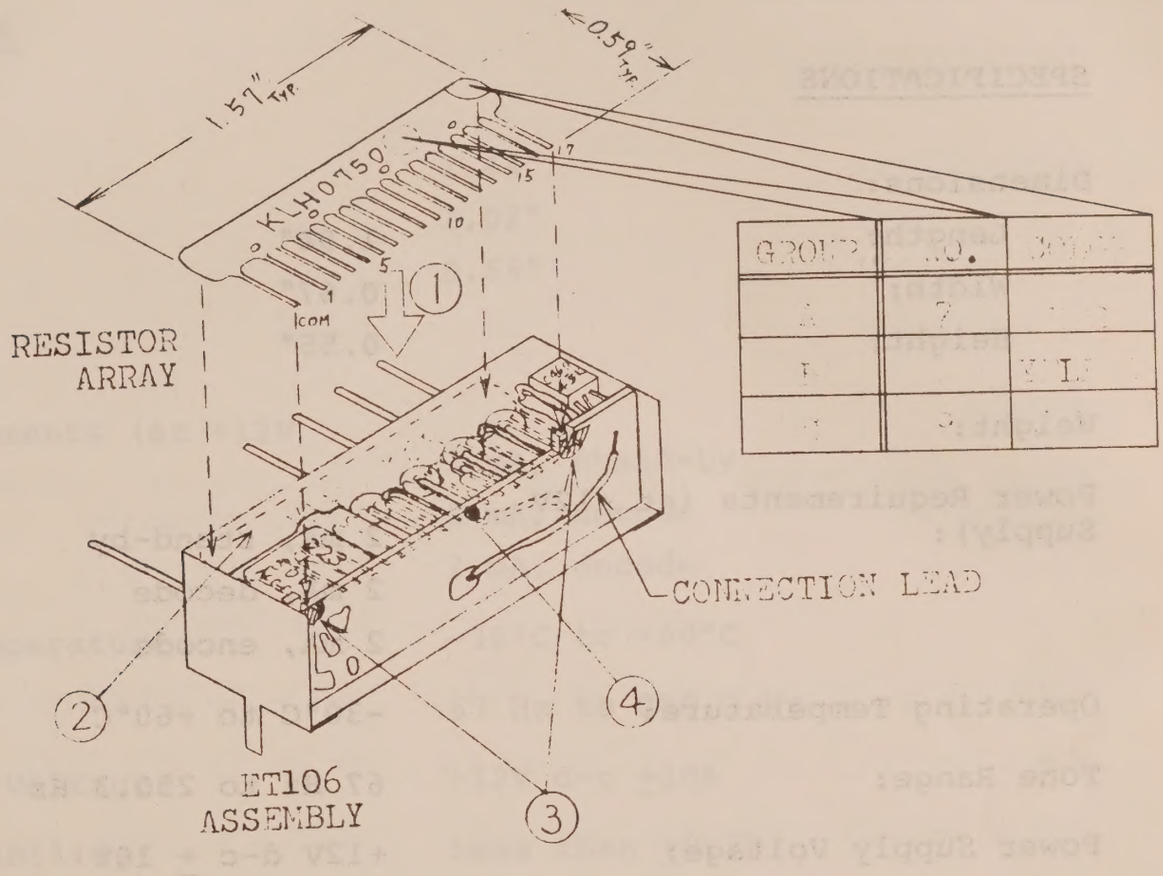
TABLE 2 TONE TABLE (Hz)

| PIN NO. | GROUP A | GROUP B | GROUP C |
|---|---|---|---|
| 1 | 250.3 | 241.8 | --- |
| 2 | 233.6 | 225.7 | --- |
| 3 | 218.1 | 210.7 | 209.0 |
| 4 | 203.5 | 192.8 | 188.0 |
| 5 | 186.2 | 179.9 | 169.0 |
| 6 | 173.8 | 167.9 | --- |
| 7 | 162.2 | 156.7 | --- |
| 8 | 151.4 | 146.2 | --- |
| 9 | 141.3 | 136.5 | 124.0 |
| 10 | 131.8 | 127.3 | --- |
| 11 | 123.0 | 118.8 | 97.4 |
| 12 | 114.8 | 110.9 | 91.5 |
| 13 | 107.2 | 103.5 | 90.0 |
| 14 | 100.0 | 94.8 | 85.4 |
| 15 | 88.5 | 82.5 | 81.0 |
| 16 | 77.0 | 71.9 | 79.7 |
| 17 | 67.0 | --- | 74.4 |

Note:

For the Resistor array A604, three kinds are provided to correspond with the tone groups in Table 2. By referring to Table 2, select the Resistor array which includes your tone frequency and connect COM and "17" pins of A604 as indicated. Then find the pin number for your tone frequency and connect that pin to pin No. 9 of A602 with connection lead.

## MOUNTING PROCEDURE OF RESISTOR ARRAY (R.ARRAY)




①. Pick up one of three R.Array(KLH07507 through KLH07509; A, B and C groups respectively) depending on the tone frequency, and place it in the specified position(indicated in dotted lines in ET106 Assembly.

②. Place the Array so that its left side can be close to the shield case of ET106 Assembly.

③. Fix the R.Array by soldering it at the hached areas.

④. To preset at the desired tone frequency, solder the free end of the connection lead to the pin for the desired tone frequency (Ref. Table 2).

## 2. SPECIFICATIONS

### 2-1. MODEL ET106

#### SPECIFICATIONS

| | |
|---|---|
| Dimensions: | |
| Length; | 1.94" |
| Width; | 0.67" |
| Height; | 0.55" |
| Weight: | |
| Power Requirements (at +12V Supply): | 2 mA, stand-by<br>2 mA, decode<br>2 mA, encode |
| Operating Temperature: | -30°C to +60°C |
| Tone Range: | 67 Hz to 250.3 Hz |
| Power Supply Voltage: | +12V d-c ± 10% |
| Frequency Stability: | Less than ±0.3% |
| Decode Sensitivity: | Less than 5 mV RMS |
| Decode Tone Signal/Noise Ratio Sensitivity: | Less than -16 dB with tone signal 10 mV RMS |
| Decode Response Time: | Less than 250 ms with tone signal 10 mV RMS |
| Decode Input Impedance: | More than 50 kΩ with 1 kHz |
| Encode Tone Level: | More than 500 mV RMS into 50 kΩ load |
| Encode Tone Distortion: | Less than 1.5% into 50 kΩ load |
| Encode Response Time: | Less than 30 ms |

## 2-2. MODEL ET111A & ET111B

### SPECIFICATIONS

| | |
|---|---|
| Dimensions: | |
| Length; | 2.44" |
| Width; | 1.02" |
| Height; | 0.59" |
| Weight: | |
| Power Requirements (at +12V Supply): | 2 mA, stand-by<br>2 mA, decode<br>2 mA, encode |
| Operating Temperature: | -30°C to +60°C |
| Tone Range: | 67 Hz to 250.3 Hz |
| Power Supply Voltage: | +12V d-c ±10% |
| Frequency Stability: | Less than ±0.3% |
| Decode Sensitivity: | Less than 5 mV RMS |
| Decode Tone Signal/Noise Ratio Sensitivity: | Less than -16 dB with tone signal 10 mV RMS |
| Decode Response Time: | Less than 250 ms with tone signal 10 mV RMS |
| Decode Input Impedance: | More than 50 kΩ with 1 kHz |
| Encode Tone Level: | More than 500 mV RMS into 50 kΩ load |
| Encode Tone Distortion: | Less than 1.5% into 50 kΩ load |
| Encode Response Time: | Less than 30 ms |

## 2-3. MODEL ET113

### SPECIFICATIONS

| | |
|---|---|
| Dimensions: | |
| Length; | 3.09" |
| Width; | 1.97" |
| Height; | 0.55" |
| Weight: | |
| Power Requirements (at +12V Supply): | 2 mA, stand-by<br>2 mA, decode<br>2 mA, encode |
| Operating Temperature: | -30°C to +60°C |
| Tone Range: | 67 Hz to 250.3 Hz |
| Power Supply Voltage: | +12V d-c ±10% |
| Frequency Stability: | Less than ±0.3% |
| Decode Sensitivity: | Less than 5 mV RMS |
| Decode Tone Signal/Noise Ratio Sensitivity: | Less than -16 dB with tone signal 10 mV RMS |
| Decode Response Time: | Less than 250 ms with tone signal 10 mV RMS |
| Decode Input Impedance: | More than 50 kΩ with 1 kHz |
| Encode Tone Level: | More than 500 mV RMS into 50 kΩ load |
| Encode Tone Distortion: | Less than 1.5% into 50 kΩ load |
| Encode Response Time: | Less than 30 ms |

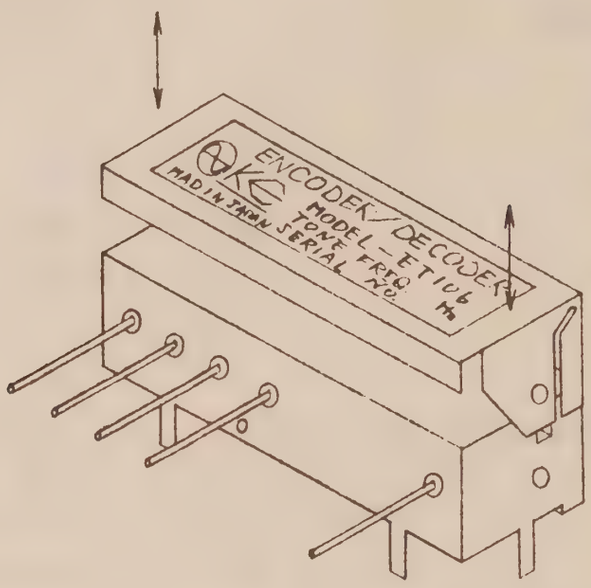
## 2-4 MODEL ET115

### SPECIFICATIONS

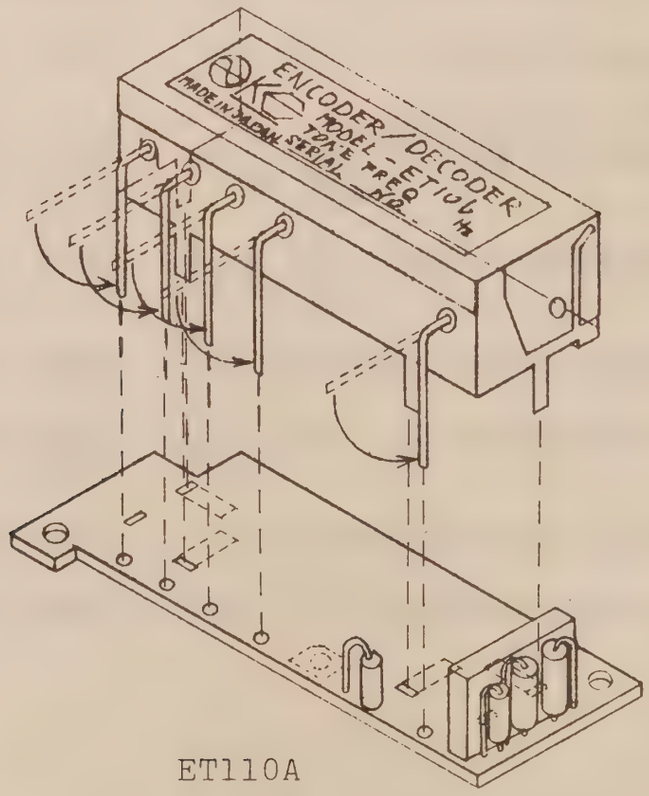
| | |
|---|---|
| Dimensions: | |
| Length; | 3.21" |
| Width: | 1.30" |
| Height; | 0.59" |
| Weight: | |
| Power Requirements (at +12V Supply): | 15 mA, stand-by<br>13 mA, decode<br>3 mA, encode |
| Operating Temperature: | -30°C to +60°C |
| Tone Range: | 67 Hz to 250.3 Hz |
| Power Supply Voltage: | +12V d-c ±10% |
| Frequency Stability: | Less than ±0.3% |
| Decode Sensitivity: | Less than 12 mV RMS |
| Decode Tone Signal/Noise Ratio Sensitivity: | Less than -16 dB with tone signal 24 mV RMS |
| Decode Response Time: | Less than 250 ms with tone signal 24 mV RMS |
| Decode Input Impedance: | More than 50 kΩ with 1 kHz |
| Encode Tone Level: | More than 500 mV RMS into 50 kΩ load |
| Encode Tone Distortion: | Less than 1.5% into 50 kΩ load |
| Encode Response Time: | Less than 30 ms |

## 3. TONE SQUELCH UNITS INSTALLATION

### 3-1. MODEL ET106

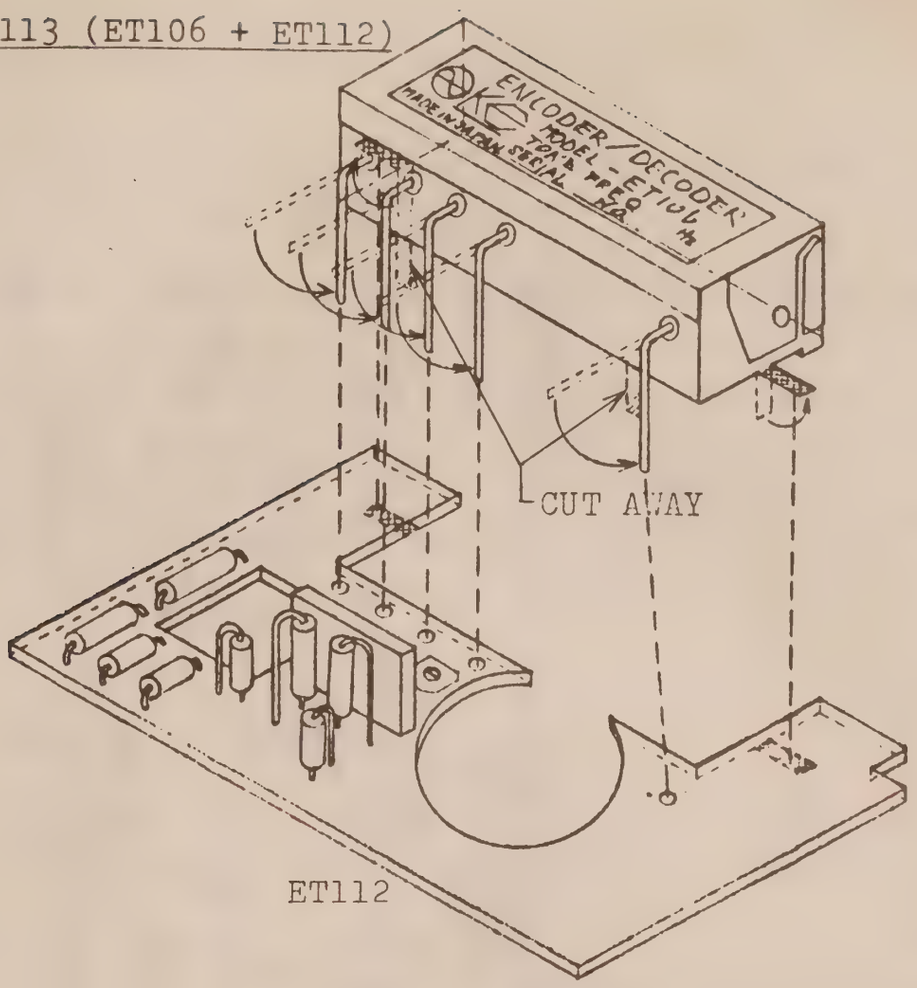



### 3-2. MODEL ET111A (ET106 + ET110A) & ET111B (ET106 + ET110B)

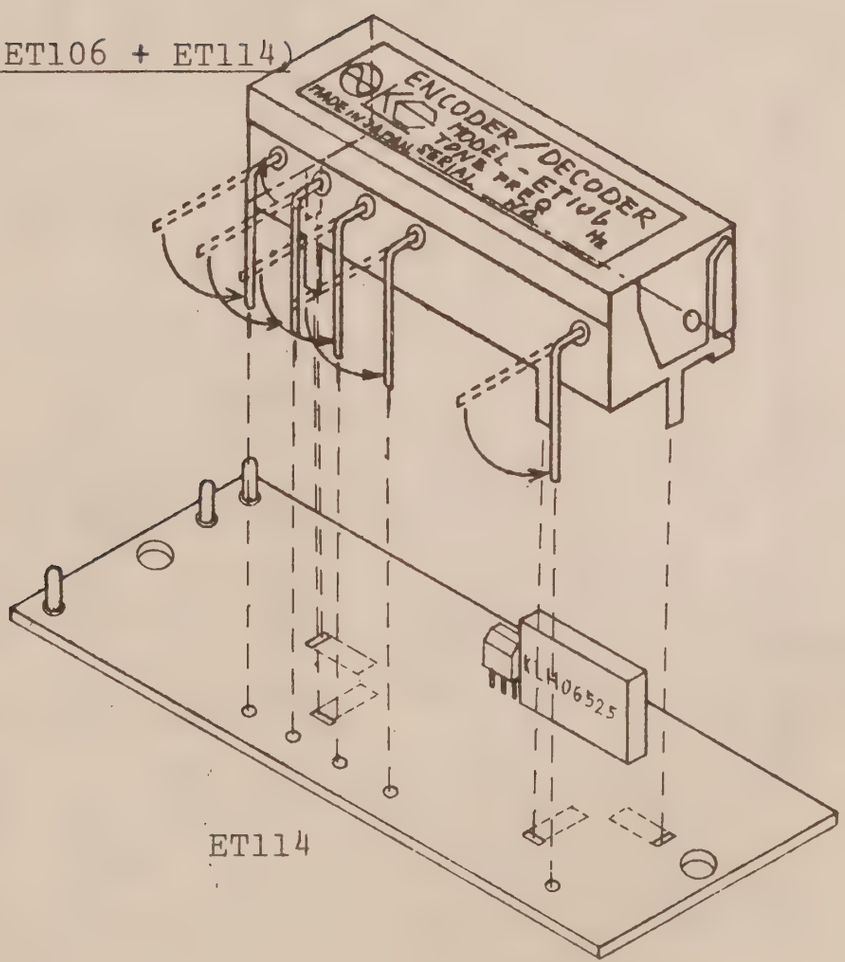



ET110A
or
ET110B

## 3-3. MODEL ET113 (ET106 + ET112)

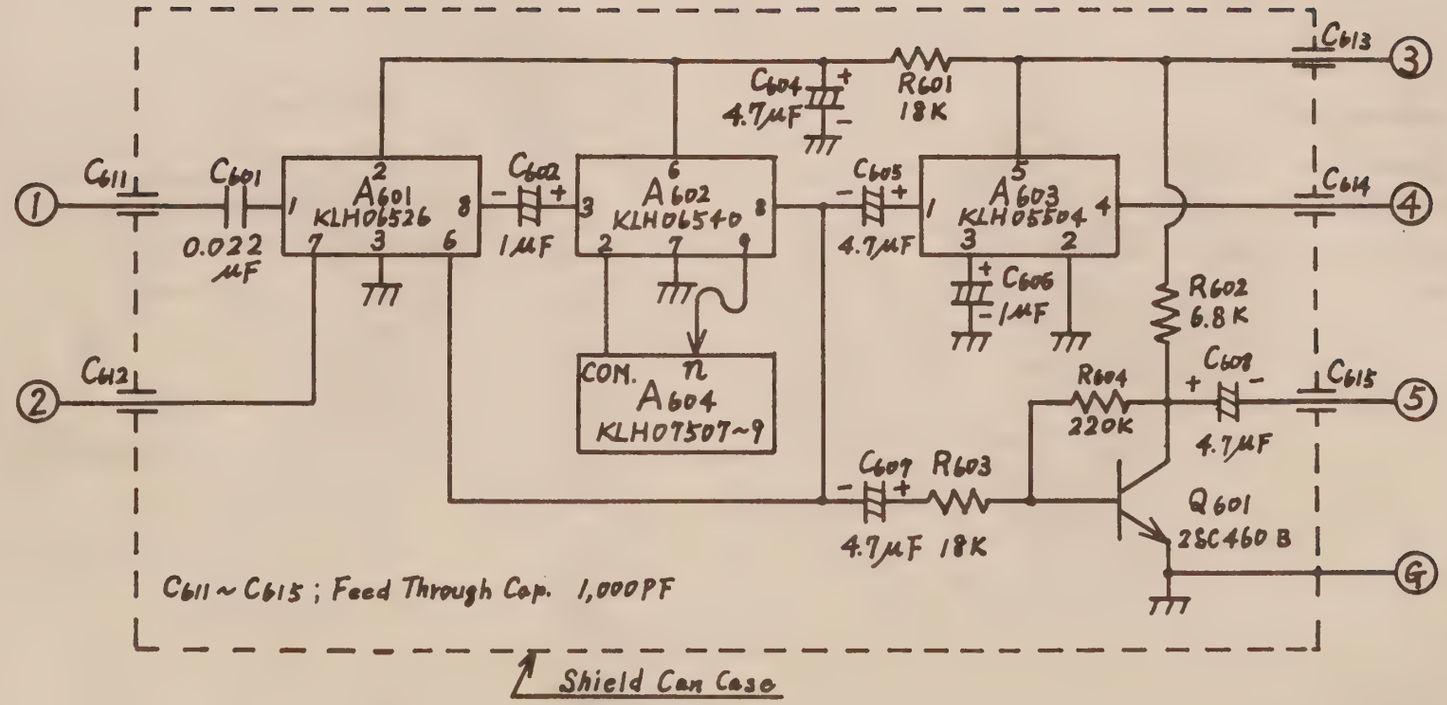



## 3-4. MODEL ET115 (ET106 + ET114)



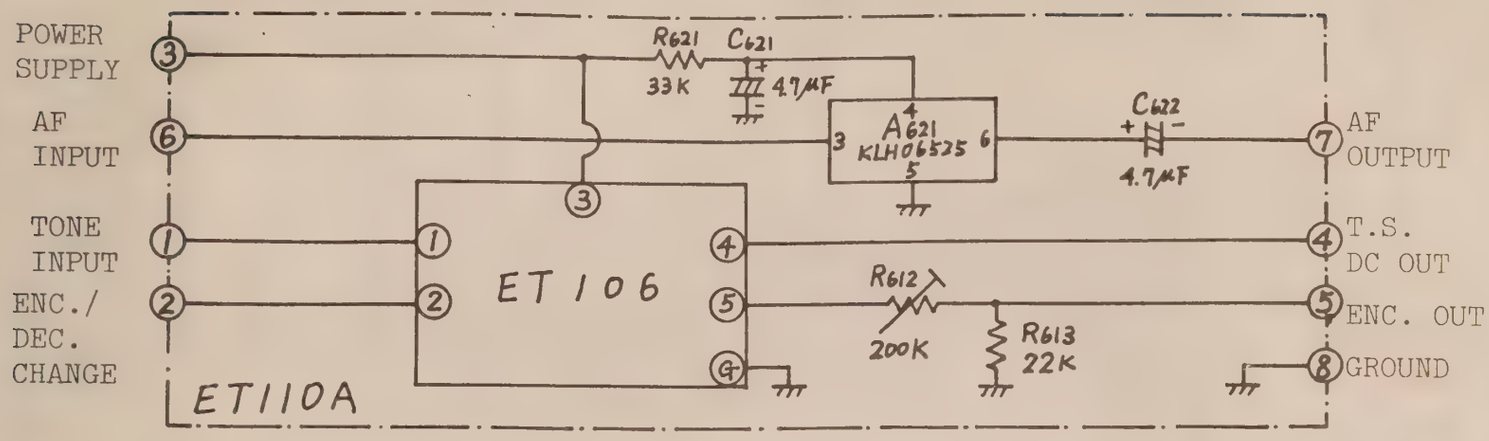
# 4. SCHEMATIC DIAGRAMS

## 4-1. ET106 SCHEMATIC DIAGRAM

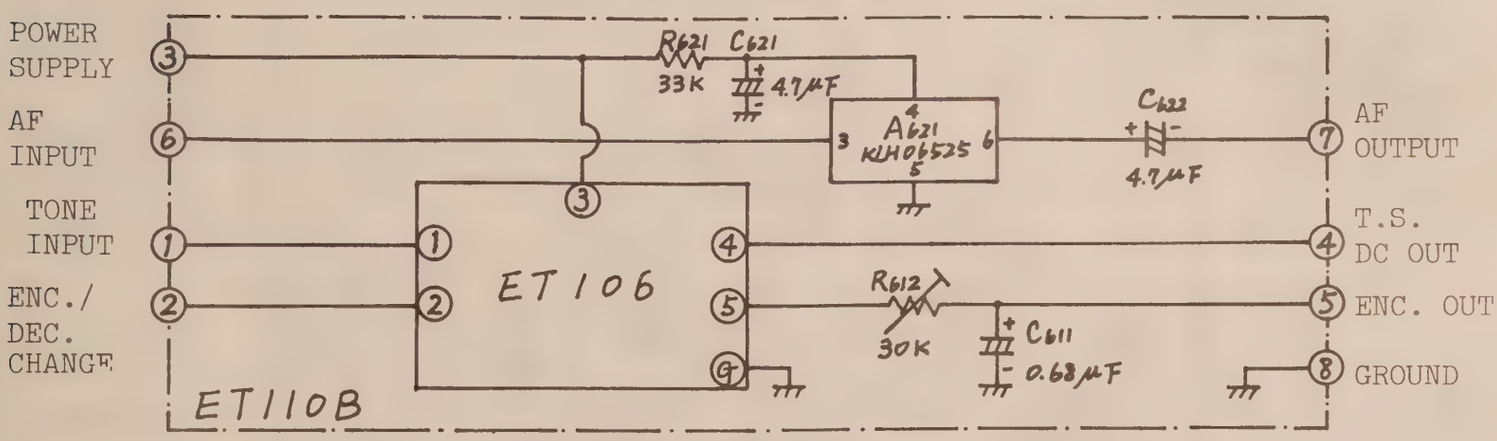


## 4-2. ET111A & ET111B SCHEMATIC DIAGRAM

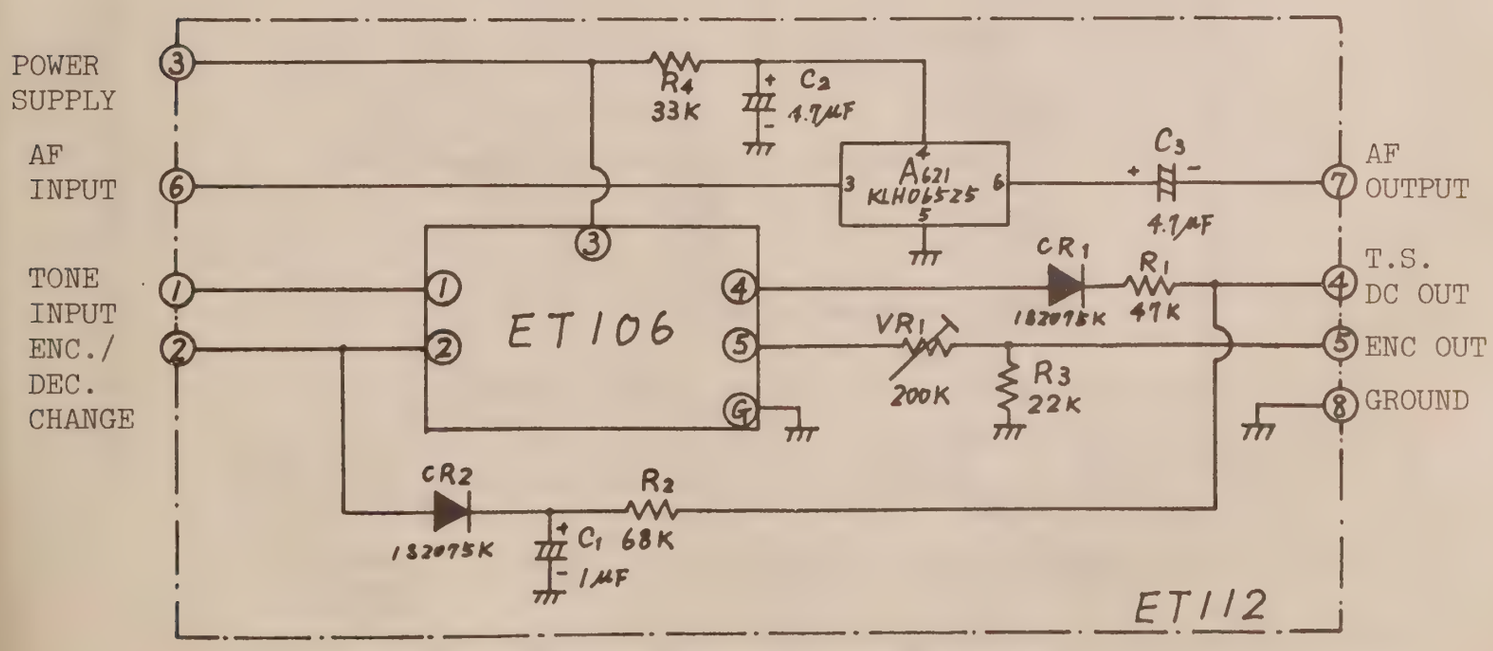
ET111A

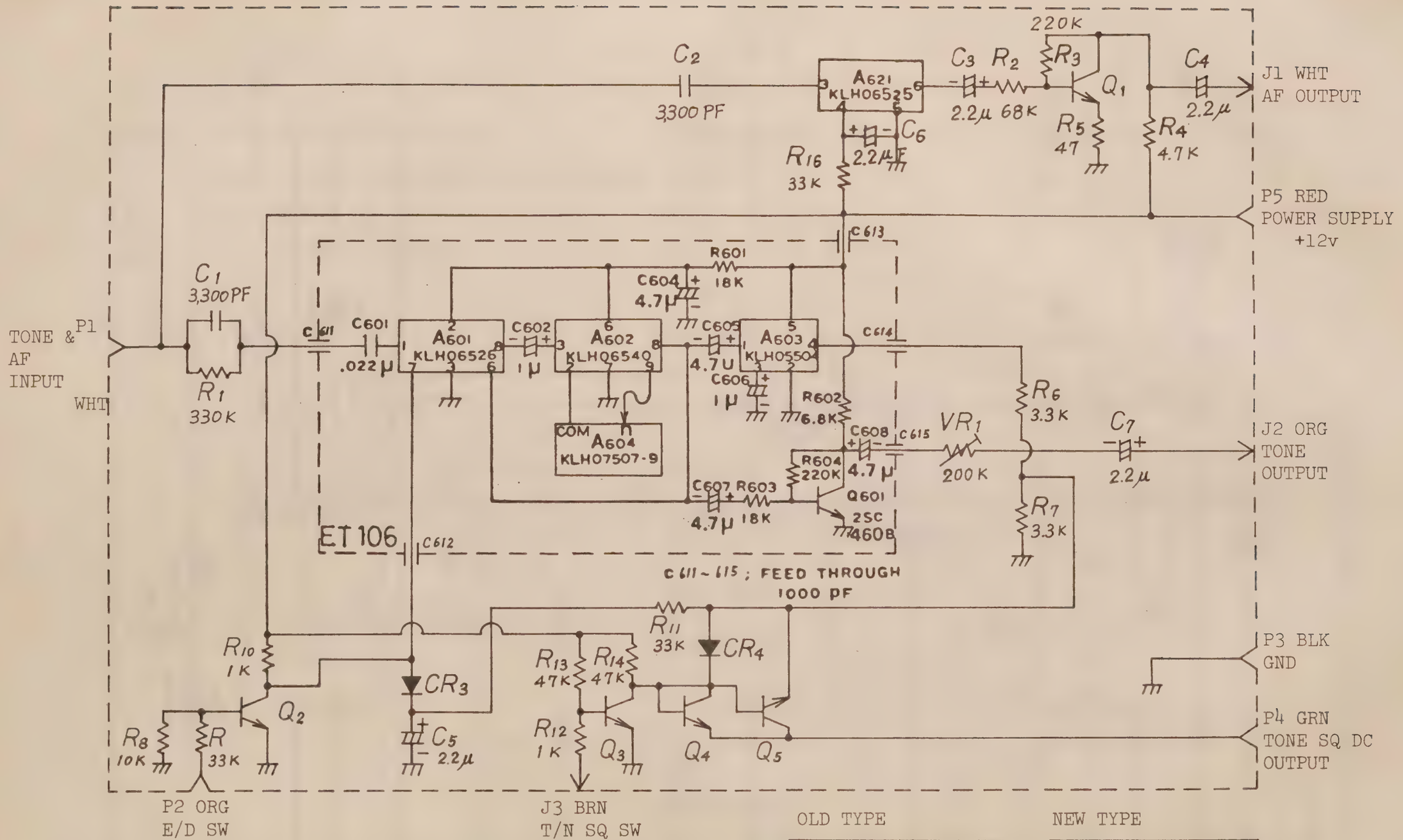



ET111B



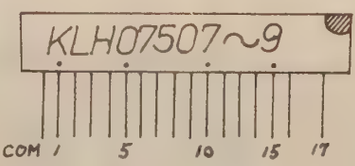

## 4-3. ET113 SCHEMATIC DIAGRAM



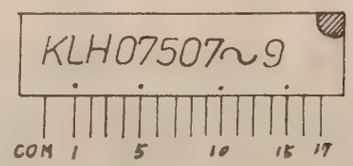



4-4. ET115 SCHEMATIC DIAGRAM

OLD TYPE




NEW TYPE




RESISTOR ARRAY (A604)

## 5. PRINTED CIRCUIT BOARDS INTERCONNECTIONS

### 5-1. ET111A (ET106 - ET110A) & ET111B (ET106 - ET110B) INTERCONNECTION

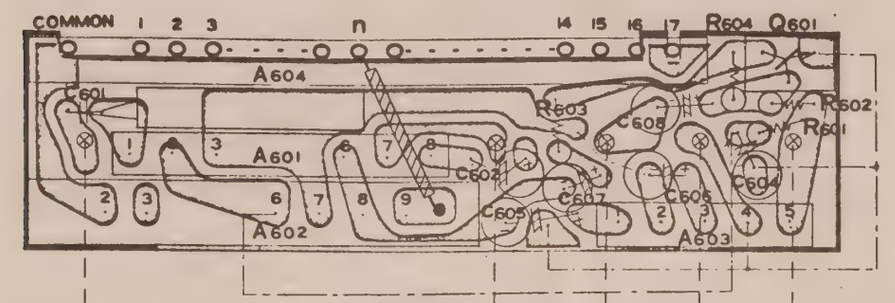
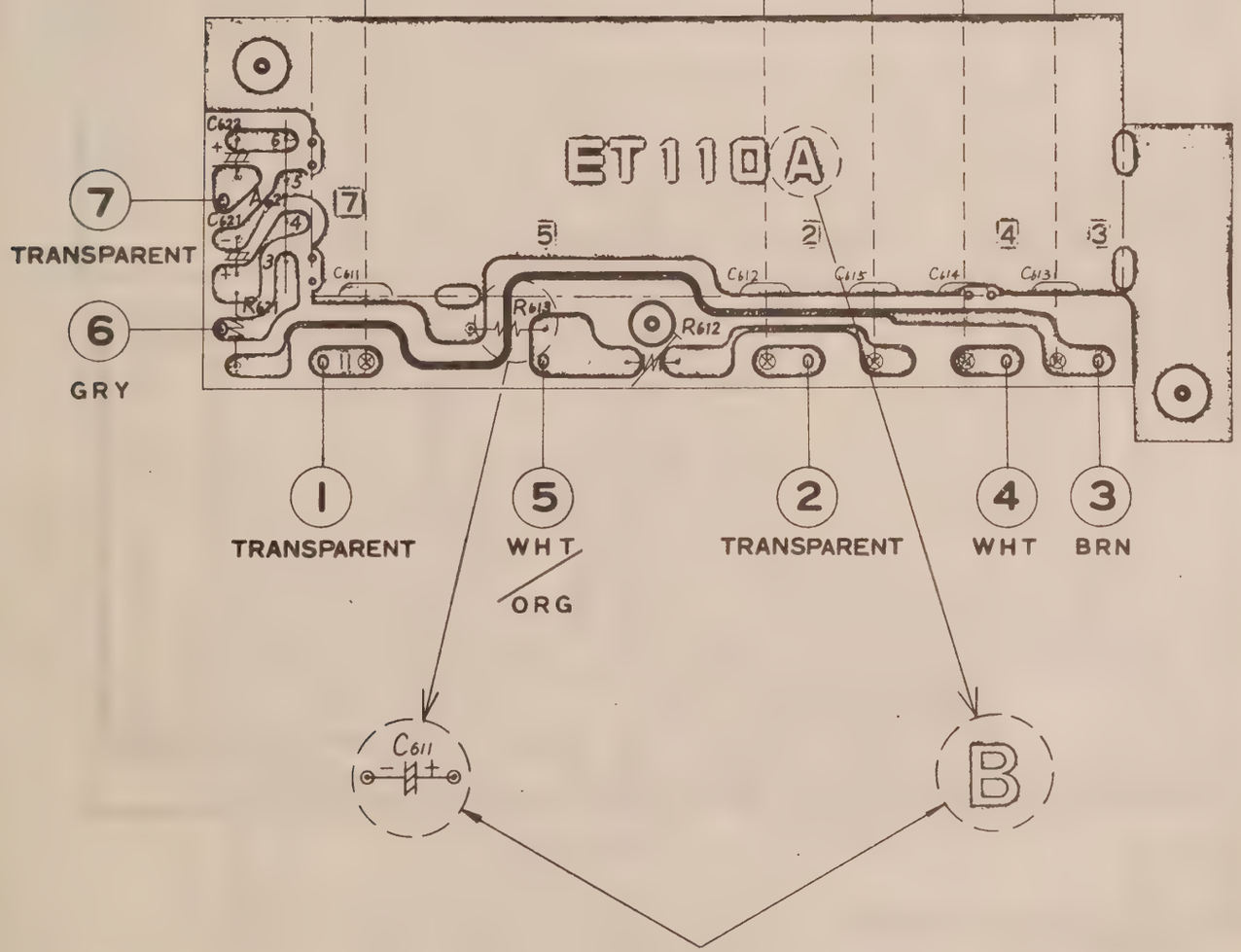



FIG.3 ET106




*NOTE: ET110B USING C611 INSTEAD OF R613.

FIG.4-1 ET110A & ET110B

ET106 / ET110A PRINTED CIRCUIT BOARDS INTERCONNECTION
(ET111A)
ET106 / ET110B
(ET111B)

## 5-2. ET113 (ET106 - ET112) INTERCONNECTION

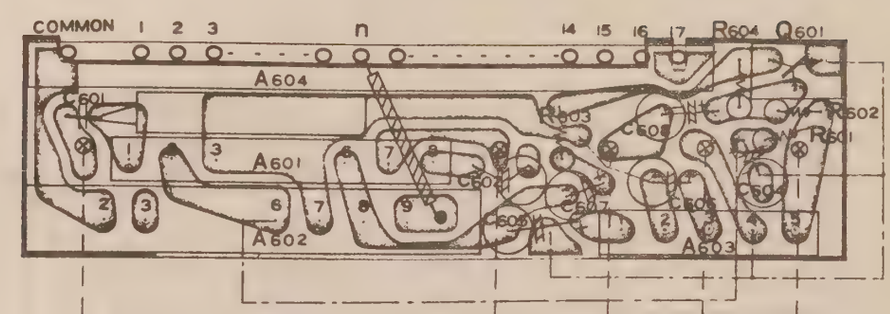
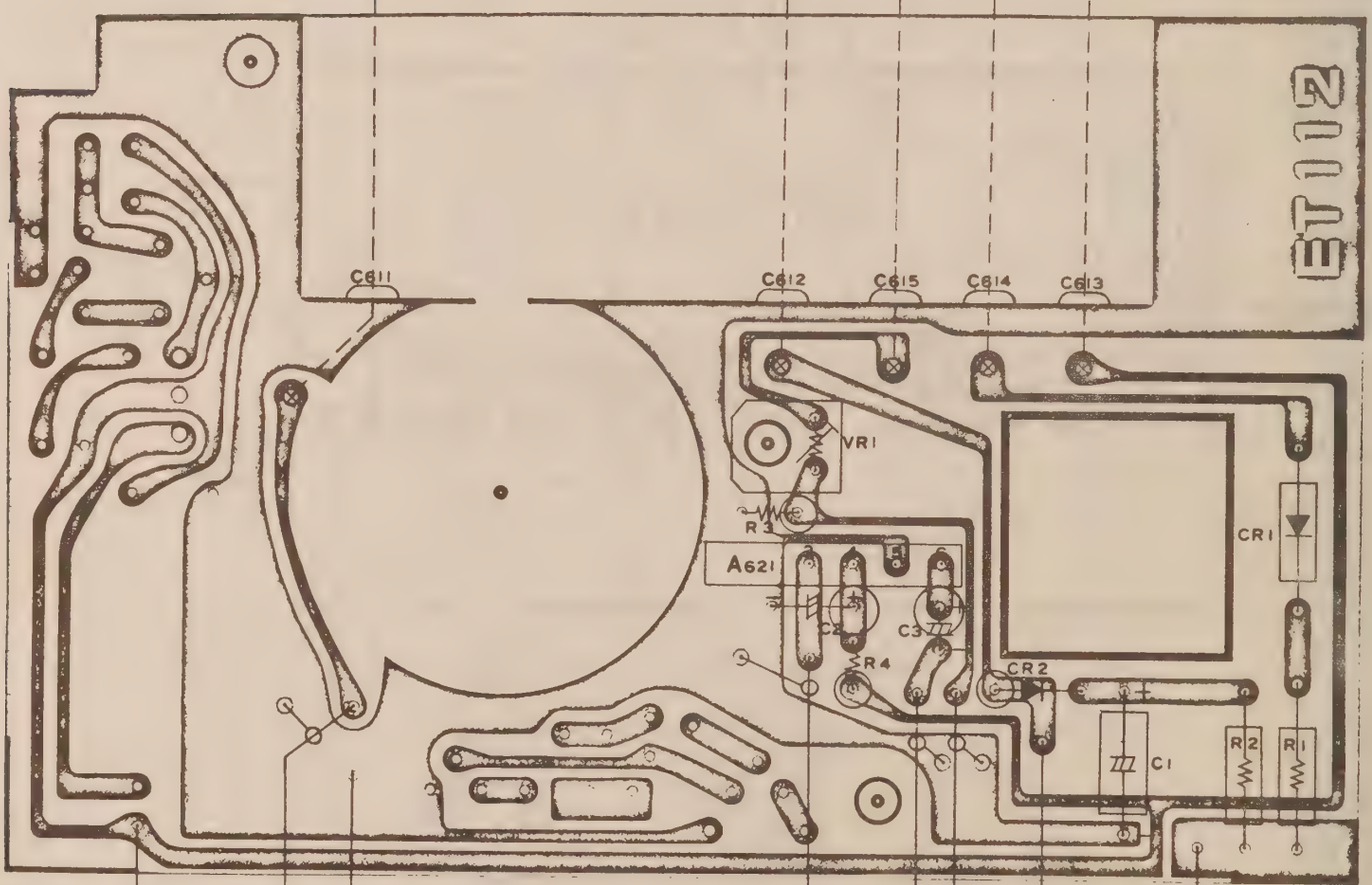



FIG. 3 ET106




3 BRN

1 8 GO TO GND
GRY GRN

6 7 5 2 4 GO TO S1001 #1
GRY GRY GRY WHT/RED WHT/BRN

FIG. 4-2 ET112

ET106 / ET112 PRINTED CIRCUIT BOARDS INTERCONNECTION
(ET113)

## 5-2'. ET113 - XF617P INTERCONNECTION

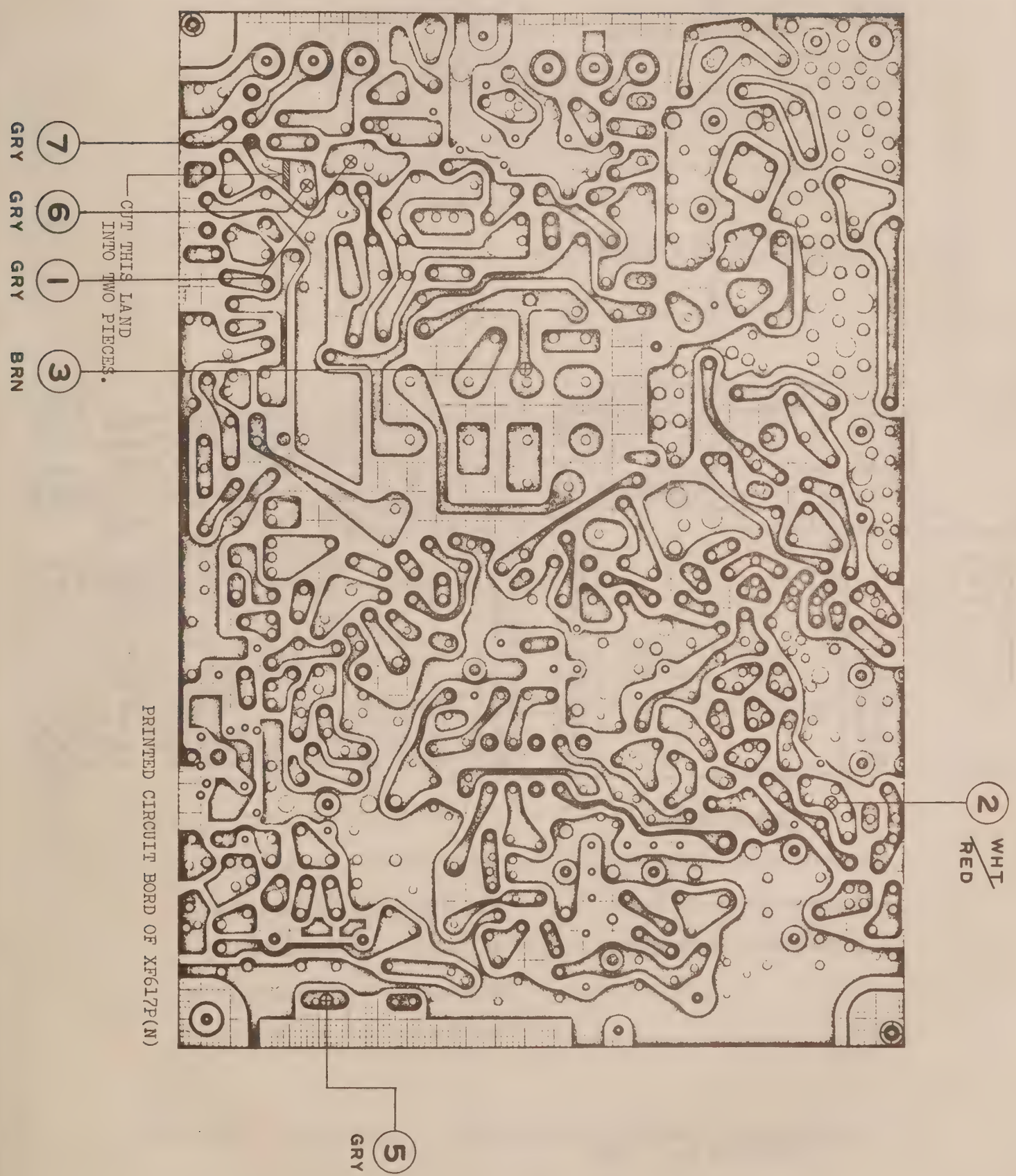



FIG. 4-2' ET113 TONE SQUELCH INTERCONNECTION
WITH XF617P TRANSCEIVER

## 5-3. ET115 (ET106 - ET114) INTERCONNECTION

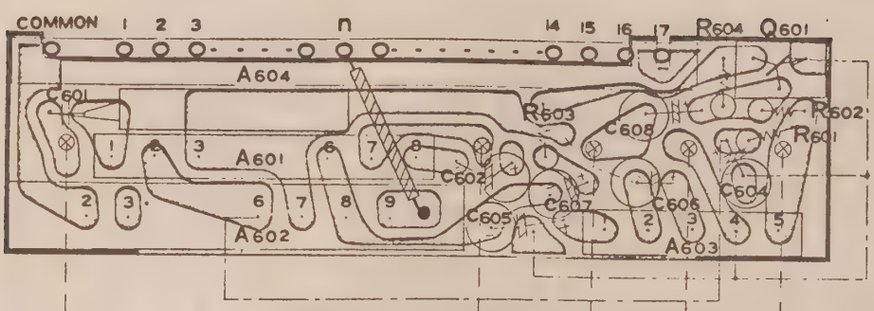
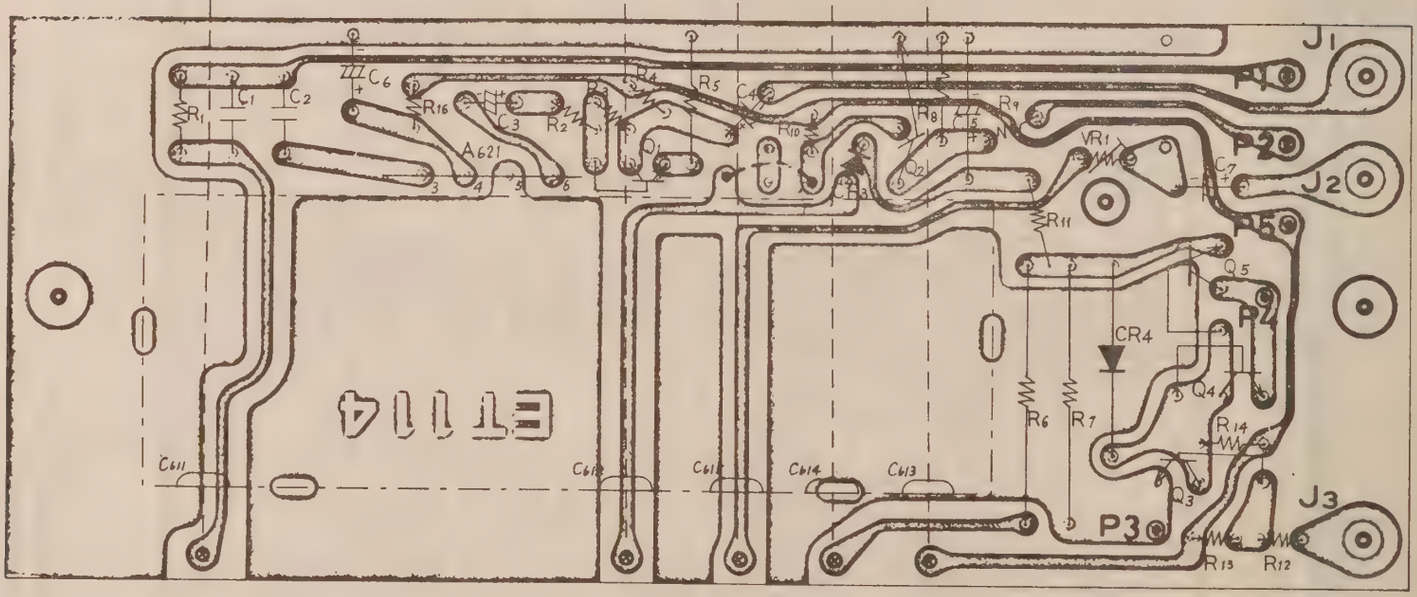



FIG.3 ET106

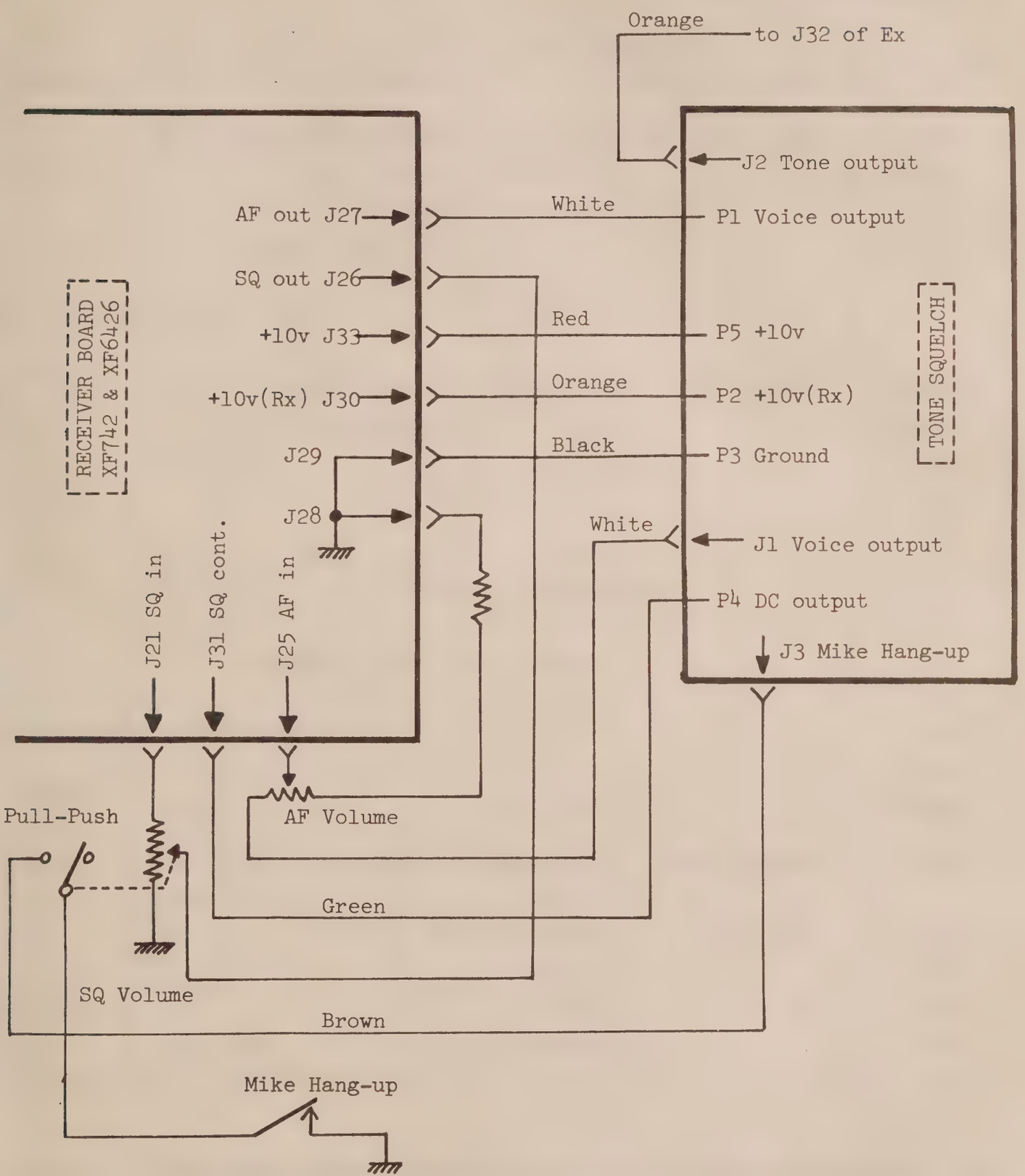



| COME FROM | GO TO |
|---|---|
| J1 (WHT) ← P (WHT) | P1 (WHT) → J27 (WHT) |
| J2 (ORG) ← P (ORG) | P2 (ORG) → J30 (ORG) |
| J3 (BRN) ← P (BRN) | P3 (BLK) → J29 (BLK) |
| | P4 (GRN) → J31 (GRN) |
| | P5 (RED) → J33 (RED) |

FIG.4-3 ET114

ET106 / ET114 PRINTED CIRCUIT BOARDS INTERCONNECTION
(ET115)

5-3'. ET115 - UHF/VHF MOBILEPHONE INTERCONNECTION




~~FIG. 4-3~~' TONE SQUELCH INTERCONNECTION WITH XF-742 & XF-6426

## 6. PARTS LISTS

### 6.1 ET106 PARTS LIST

| SYMBOL No. | NAME OF PARTS | DESCRIPTION | Q'TY | REMARKS |
|---|---|---|---|---|
| A601 | HIC MODULE | KLH06526 LPF&OSC.DRIVER | 1 | |
| A602 | " | KLH06540 ACTIVE BPF | 1 | |
| A603 | " | KLH05504 DETECTOR | 1 | |
| * A604 | " | KLH07507 RESISTOR ARRAY | 1 | GROUP A |
| * " | " | KLH07508 " " | 1 | " B |
| * " | " | KLH07509 " " | 1 | " C |
| C601 | CAPACITOR | 0.022uF 50V POLY.FILM | 1 | |
| C602 | " | 1uF 25V TANTALUM | 1 | |
| C604 | " | 4.7uF 6.3V " | 1 | |
| C605 | " | " " " | 1 | |
| C606 | " | 1uF 25V " | 1 | |
| C607 | " | 4.7uF 6.3V " | 1 | |
| C608 | " | " " " | 1 | |
| C611 | " | 1000pF 50V FEED THROUGH | 1 | |
| C612 | " | " " " | 1 | |
| C613 | " | " " " | 1 | |
| C614 | " | " " " | 1 | |
| C615 | " | " " " | 1 | |
| Q601 | TRANSISTOR | 2SC460B SILICON | 1 | |
| R601 | RESISTOR | 18kΩJ 1/10W CARBON | 1 | |
| R602 | " | 6.8kΩJ " " | 1 | |
| R603 | " | 18kΩJ " " | 1 | |
| R604 | " | 220kΩJ " " | 1 | |

NOTE; *A604(RESISTOR ARRAY;KLH07507,8,9) IS NOT INCLUDED IN ET106 ASSEMBLY.

## 6-2A ET110A PARTS LIST

| SYMBOL NO. | NAME OF PARTS | DESCRIPTION | Q'TY. | REMARKS |
|---|---|---|---|---|
| A621 | HIC MODULE | KLH06525 HPF | 1 | |
| C621 | CAPACITOR | 4.7μF 6.3V TANTALUM | 1 | |
| C622 | " | " " " | 1 | |
| R612 | VARI.RESISTOR | 200kΩ | 1 | |
| R613 | RESISTOR | 22kΩJ 1/10W CARBON | 1 | |
| R621 | " | 33 " " " | 1 | |

## 6-2B. ET110B PARTS LIST

| SYMBOL NO. | NAME OF PARTS | DESCRIPTION | Q'TY. | REMARKS |
|---|---|---|---|---|
| A621 | HIC MODULE | KLH06525 HPF | 1 | |
| C611 | CAPACITOR | 0.68μF 20V TANTALUM | 1 | |
| C621 | " | 4.7μF 6.3V " | 1 | |
| C622 | " | " " " | 1 | |
| R612 | VARI.RESISTOR | 30kΩ | 1 | |
| R621 | RESISTOR | 33kΩJ 1/10W CARBON | 1 | |

## 6-3. ET112 PARTS LIST

| SYMBOL NO. | NAME OF PARTS | DESCRIPTION | Q'TY. | REMARKS |
|---|---|---|---|---|
| A621 | HIC MODULE | KLH06525 HPF | 1 | |
| C1 | CAPACITOR | 1μF 25V TANTALUM | 1 | |
| C2 | " | 4.7μF 6.3V " | 1 | |
| C3 | " | " " " | 1 | |
| CR1 | DIODE | 1S2075K SILICON | 1 | |
| CR2 | " | " " | 1 | |
| R1 | RESISTOR | 47kΩJ 1/10W CARBON | 1 | |
| R2 | " | 68 " " " | 1 | |
| R3 | " | 22 " " " | 1 | |
| R4 | " | 33 " " " | 1 | |
| VR1 | VARI.RESISTOR | 200kΩMAX | 1 | |

## 6-4. ET114 PARTS LIST

| SYMBOL No. | NAME OF PARTS | DESCRIPTION | Q'TY | REMARKS |
|---|---|---|---|---|
| A621 | HIC MODULE | KLH06525 HPF | 1 | |
| C1 | CAPACITOR | 3300pF 50V POLY.FILM | 1 | |
| C2 | " | " " " | 1 | |
| C3 | " | 2.2uF 10V TANTALUM | 1 | |
| C4 | " | " " " | 1 | |
| C5 | " | " " " | 1 | |
| C6 | " | " " " | 1 | |
| C7 | " | " " " | 1 | |
| CR3 | DIODE | 1S2075K SILICON | 1 | |
| CR4 | " | 1N34A GERMANIUM | 1 | |
| Q1 | TRANSISTOR | 2SC458C SILICON | 1 | |
| Q2 | " | " " | 1 | |
| Q3 | " | " " | 1 | |
| Q4 | " | " " | 1 | |
| Q5 | " | " " | 1 | |
| R1 | RESISTOR | 330kΩJ 1/10W CARBON | 1 | |
| R2 | " | 68 " " " | 1 | |
| R3 | " | 220" " " | 1 | |
| R4 | " | 4.7" " " | 1 | |
| R5 | " | 47ΩJ " " | 1 | |
| R6 | " | 3.3kΩJ " " | 1 | |
| R7 | " | " " " | 1 | |
| R8 | " | 10 " " " | 1 | |
| R9 | " | 33 " " " | 1 | |
| R10 | " | 1 " " " | 1 | |
| R11 | " | 33 " " " | 1 | |
| R12 | " | 1 " " " | 1 | |
| R13 | " | 47 " " " | 1 | |
| R14 | " | " " " | 1 | |
| R16 | " | 33 " " " | 1 | |
| VR1 | VARI.RESISTOR | 200kΩMAX | 1 | |